Company: Canadian Oxygen Limited
Title: An Assessment of the Commercial Feasibility of the CANMET Developed Rapid Investment Shell Process.

9-9020
OSTB-00212
V.A. - E. Szabo (PMRL)

DELORO STELLITE December 4, 1979

RAPID INVESTMENT SHELL REPORT

A number of tests have been carried out at Deloro Stellite to assess the technical feasibility of the Rapid Investment Shell process as developed by Dr. Szabo of the Department of Energy, Mines & Resources. These tests have met with mixed success.

Due to supply problems, the early trials did not use the exact materials called for in Dr. Szabo's paper.*1 The first run used Molochite Flour and sand in place of Alumina and Zircon materials. Serious slumping problems occurred when a mould was dipped, with large pieces of shell material dropping off into the slurry tanks and fluidized sand beds. Problems persisted even when slurry viscosities were altered and different sands (including Dr. Szabo's zircon sand) were used.

The binder slurry was then remixed using ethyl silicate produced by the Scientific Authority, and the same problems occurred. This alleviated fears that the Deloro Stellite ethyl silicate had been improperly prepared.

The tests were run again using Nalcoag 1030 (instead of 1034 (a)) and Tam G Zircon Flour. A shell was obtained with this method; however, after overnight drying, cracks and fissures appeared and the mould was easily damaged in handling. Autoclave dewaxing resulted in a blistered, brittle mould.

When all of the required materials had arrived, a trial was run using the exact materials and proportions suggested by Dr. Szabo. This resulted in a binder solution considerably thicker than the water base slurry. To help reduce shearing forces on the mould layers, a sand rainer was used instead of a fluidized bed, and slurry tank mixers were stopped a few seconds prior to dipping.

A test bar assembly was dipped under these conditions. Serious slumping occurred after the fourth and fifth dips. This lead to the early application of the last slurry - leaving the mould two layers short of the required coating. As the wet mould could not be handled, difficulty was encountered when the dipping handle was to be unscrewed from the mould. Eventually, the rim of the cruicible was grasped, which left fingerprints (down to the wax) in this area.

The mould was left to dry over the weekend. After the 65 hours of drying, the mould was still cold and damp to the touch and the shell material was soft and easily gouged with a fingernail. Autoclave dewaxing resulted in a very hard shell with minimal cracking visible in the primary coat. The rim of the cruicible had crumbled away where the wet mould had been handled.

---

*1 On the Preparation of Investment Shell Mould (Two Rapid Methods), August, 1975.

3pp

MICROMEDIA

....2

The mould was cast in Deloro Stellite Grade 4 Battery. Some leakage occurred but a casting with an average, to below average, surface finish was attained.

The last trial run used slurries of nearly equal viscosity (19-21 seconds in #4 Zahn cup). Wax feet were attached to the mould cruicibles to allow for easier handling.

The first test bar assembly dipped well, and all eight (8) of the required coats were applied. Slight slumping occurred. This mould, however, broke when placed on the counter to dry.

The second assembly was dipped, and a reasonable shell attained. This assembly was then allowed to dry overnight (17 hours), but after this period the shell was still quite damp. It disintegrated during autoclave dewaxing.

Our trials thus far have revealed some major problems in our reproduction of the Rapid Shell Process. The first being that the time savings ascribed to this process are lost through a combination of factors:

1) To prevent slumping, a longer draining time after each dip is required - about 60 seconds. This is about the same length of time it takes to remove and re-fasten a mould to the dipping handle during conventional dipping.

2) In our trials the drying time for a mould is greater than 17 hours. This means, then, that the mould storage requirements and production time would be comparable to our present procedure.

3) Wax patterns must be modified to allow the removal of the dipping handle from the wet mould. This results in added time and material expense in the wax room.

4) The need to repeatedly stop and start the slurry tank mixers while dipping not only contributes to the time element, but it creates an additional step in the dipping routine and introduces a wear factor for the machinery.

The slumping problem always seems to be present in varying degrees. Only small moulds have been dipped, to date, and there is a real possibility that this problem will be accentuated with increasing part size. The fragility of the wet mould may also worsen in larger parts. In this process, the wax tree must supply the sole support for the heavy, wet, shell material. Any bumps or uneven pressure seem to cause breakage at weak points in the wax assembly. Thus, wet moulds are not only awkward to handle, but they must be moved with great care.

....3

I am sure that the Rapid Investment Shell Process could be adapted to produce acceptable castings in an industrial setting; however, at its present state of development it offers no savings in time, and only limited savings in space over our present moulding method.

B J Wright

BW/nw

Barbara Wright, B.Sc.
Assistant to Q.C. Manager